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PTO/SB/21 (12-97)
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	Filing Date	9/29/00
	First Named Inventor	Edward Friery
	Group Art Unit	Not Known
	Examiner Name	Not Known
Total Number of Pages in This Submission	39	Attorney Docket Number 14097

ENCLOSURES (check all that apply)		
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Signature	<i>Gary A. Robinette</i>
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First Named Inventor	Edward Friery
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Attorney Docket No.	14097

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106 310	206 155	Design filing fee	
107 480	207 240	Plant filing fee	
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114 150	214 75	Provisional filing fee	

SUBTOTAL (1) (\$) 690.00**2. EXTRA CLAIM FEES**

Total Claims	Extra Claims	Fee from below	Fee Paid
29	20** = 9	18	162
4	3** = 1	78	78
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Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
103 18	203 9	Claims in excess of 20	
102 78	202 39	Independent claims in excess of 3	
104 260	204 130	Multiple dependent claim, if not paid	
109 78	209 39	** Reissue independent claims over original patent	
110 18	210 9	** Reissue claims in excess of 20 and over original patent	

SUBTOTAL (2) (\$) 240.00**FEE CALCULATION (continued)****3. ADDITIONAL FEES**

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105 130	205 65	Surcharge - late filing fee or oath	
127 50	227 25	Surcharge - late provisional filing fee or cover sheet	
139 130	139 130	Non-English specification	
147 2,520	147 2,520	For filing a request for reexamination	
112 920*	112 920*	Requesting publication of SIR prior to Examiner action	
113 1,840*	113 1,840*	Requesting publication of SIR after Examiner action	
115 110	215 55	Extension for reply within first month	
116 380	216 190	Extension for reply within second month	
117 870	217 435	Extension for reply within third month	
118 1,360	218 680	Extension for reply within fourth month	
128 1,850	228 925	Extension for reply within fifth month	
119 300	219 150	Notice of Appeal	
120 300	220 150	Filing a brief in support of an appeal	
121 260	221 130	Request for oral hearing	
138 1,510	138 1,510	Petition to institute a public use proceeding	
140 110	240 55	Petition to revive - unavoidable	
141 1,210	241 605	Petition to revive - unintentional	
142 1,210	242 605	Utility issue fee (or reissue)	
143 430	243 215	Design issue fee	
144 580	244 290	Plant issue fee	
122 130	122 130	Petitions to the Commissioner	
123 50	123 50	Petitions related to provisional applications	
126 240	126 240	Submission of Information Disclosure Stmt	
581 40	581 40	Recording each patent assignment per property (times number of properties)	40.00
146 690	246 345	Filing a submission after final rejection (37 CFR § 1.129(a))	
149 690	249 345	For each additional invention to be examined (37 CFR § 1.129(b))	
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of

and

for

AIRBAG PRODUCTS WITH NONLINEAR TEAR SEAMS

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AIRBAG PRODUCTS WITH NONLINEAR TEAR SEAMS

BACKGROUND OF THE INVENTION

1. The Field of the Invention

The present invention relates to safety restraint devices for vehicles. More specifically, the present invention relates to hidden seams designed to permit airbag deployment without any evidence of the seam visible to a user.

2. The Relevant Technology

The inclusion of inflatable safety restraint devices, or airbags, is now a legal requirement for many new vehicles. Airbags are typically installed in the steering wheel and in the dashboard on the passenger side of a car. In the event of an accident, an accelerometer within the vehicle measures the abnormal deceleration and triggers the ignition of an explosive charge. Expanding gases from the charge fill the airbags, which immediately inflate in front of the driver and passenger to protect them from impact against the windshield.

During normal operation, the airbags are stowed behind covers to protect them from tampering and provide a more attractive interior facade for the vehicle. Seams, or deliberately weakened portions of the cover material, are included in the covers to ensure that the airbags deploy properly. Seams are necessary because, if the entire cover is made uniformly strong, random factors, such as manufacturing defects, in the cover will determine where the airbag emerges. It is necessary to ensure that deployment occurs at the proper location and time. Otherwise, a driver or passenger may not receive protection from the airbags, or may even be injured by improperly inflating airbags.

A seam may be a gap in the cover, held shut by threads, adhesives, etc. In the alternative, a seam may be constitute a line across the cover in which the material of the

1 cover is formed thinner. In any case, the seam creates an inwardly-sloping region on the
2 airbag cover. The seam may be on the inside of the cover, facing the airbag, or on the
3 outside. Some covers include an outer layer of attractive material, such as leather, vinyl, or
4 another plastic, that matches the remainder of the vehicle's interior. This layer also serves
5 to cover the seam and hide it from view.

6 Other covers are made through "single-shot" construction, i.e., a manufacturing
7 process in which only one single material is used. No cover layer is then used; rather, the
8 surface facing the vehicle interior is made into a cosmetic surface through shaping and
9 texturing. Styling lines are then typically molded into the cosmetic surface to obscure the
10 underlying seam.

11 However, prior art seams typically have at least one long, straight section. Because
12 of manufacturing methods currently used to attach the outer layer, the outer layer, if used,
13 typically form-fits to the seam, creating an indentation in the outer layer over the seam. If
14 no outer layer is used, a similar problem results because the styling line does not effectively
15 fool anyone, and the styling line itself may be unsightly. If the styling line is omitted, a user
16 may then "read through" the cosmetic surface and perceive the seam. Read through occurs
17 because deformation of the material around the seam creates a visible indentation on the
18 cosmetic surface. In many cases, the material of the seam is so thin that it is translucent to
19 a user, who may then look through the cosmetic surface to perceive the seam or even the
20 airbag inside the cover.

21 Consequently, nearly every vehicle with an airbag has a straight indentation or
22 styling line in the interior finish. Since most airbags are placed at a location where they can
23 protect a user from frontal impact, this indentation is nearly always directly in front of a
24 person, in plain view. For this reason, the steering wheel and the passenger side dashboard
25 of many vehicles prominently display a straight indentation or styling line covering the
26 airbag.

1 The visible seam is problematic for a number of reasons. It may upset the design
2 scheme of the interior material of the vehicle. Many modern vehicles utilize a smooth
3 interior design that may be disrupted by the appearance of a seam in the middle of a panel.
4 An automobile manufacturer may wish to employ curvilinear patterns on the interior finish
5 of the vehicle. When combined with the straight indentations formed by prior art seams,
6 however, such curvilinear patterns may appear incongruous and distracting.

7 Furthermore, a visible seam invites tampering by curious children and others. The
8 seam is designed to yield to opening force, so it may be fairly easily broken to expose the
9 airbag. If the airbag is tampered with, the owner may have to replace it, or may even be
10 injured if it fails to deploy in the event of an accident. Even if no break is formed in the
11 seam, the surface of the outer layer may be ruined by constant picking, poking, and
12 scratching.

13 Moreover, another danger is present in vehicles in which interior airbag seams are
14 visible. Some people form a habit of resting their hands in a certain fixed position on a
15 surface, particularly over an irregularity such as a ridge, bump, or seam. For example, a
16 driver may, while driving, subconsciously rub his or her fingers along the seam. Besides
17 damage to the interior finish of the vehicle, this may ultimately cause injury to the driver
18 when the airbag deploys. The rapid timing required to inflate an airbag before a person has
19 struck a surface in the vehicle (such as the windshield) requires that the airbags open with
20 explosive force. This will not typically injure a user situated normally in the vehicle, but
21 body parts resting too close to the airbag, such as arms and hands, will be subject to the
22 explosive force of the airbag's deployment. A user could then suffer serious injuries when
23 the airbag deploys.

24 Even when known seams is not visible, they may be easily discovered by a user by
25 simply pressing on the outer layer or cosmetic surface. In either case, if a linear seam is used
26 behind the outer layer or cosmetic surface, the pressure causes the cover to fold inward along

1 the seam, so that the seam is readily perceptible. Repeated application of pressure may even
2 break the seam. Even if a seam is not otherwise visible, it is preferable, for many reasons,
3 to ensure that it is entirely hidden from a user until the airbag deploys.

4 Accordingly, a need exists for a safety restraint device cover with a seam that will
5 not be visible to a vehicle occupant, even when no styling line is used. The indentation
6 produced by the seam is difficult to eradicate without the use of additional manufacturing
7 processes to join disparate materials or alter the shape of the seam. Consequently, a need
8 exists for a novel seam design that will not show through the outer layer, if a separate
9 material is applied, or the cosmetic surface, if a single-shot, or single material process is used
10 to form the cover. A need further exists for such a cover that is manufacturable through
11 inexpensive processes such as stamping or molding.

12 13 **BRIEF SUMMARY OF THE INVENTION**

14 The apparatus of the present invention has been developed in response to the present
15 state of the art, and in particular, in response to the problems and needs in the art that have
16 not yet been fully solved by currently available airbag covers. Consequently, the present
17 invention provides an easily manufactured airbag cover with a seam that remains hidden
18 from view.

19 In accordance with the invention as embodied and broadly described herein in the
20 preferred embodiment, a cover, including a novel seam design, is provided. The cover
21 comprises a module insertable into a corresponding opening in the vehicle. An outer layer
22 may also be applied to the module to hide the module from view. A seam may be formed
23 in an outward-facing surface of the module to permit airbag deployment. The seam
24 comprises a nonlinear portion, which includes a plurality of bends that discourage form-
25 fitting of an outer layer over the seam. The bends may exist in a variety of configurations
26 suitable for keeping the outer layer from folding into the seam. This permits the use of

1 simple manufacturing processes, such as stamping and molding, to create the seam, without
2 leaving an unsightly and potentially dangerous crease in the outer layer.

3 In the alternative, instead of the outer layer, a cosmetic surface may be formed on
4 a portion of the module facing the vehicle interior. The nonlinear seam may then be formed
5 in an inward-facing surface of the module. Such a nonlinear seam minimizes read through
6 because the material does not deform uniformly to produce a translucent line. Even if the
7 nonlinear seam does create translucent regions in the cosmetic surface, the translucent
8 regions will be nonlinear, such that there is no viewpoint from which a user may see through
9 any significant portion of the cover. There is no linear, regular feature to draw a viewer's
10 attention.

11 Additionally, whether an outer layer or cosmetic surface is used, if a user presses
12 against the cover, the cover does not deflect in such a way that the seam is easily discovered.
13 The seam extends along multiple axes so that bending does not occur only along one axis,
14 as with a linear seam. Rather, bending occurs along multiple axes, as would be expected for
15 a surface with no weakened portions. In effect, since the seam, which forms a weakened
16 region, is irregular, it will not be perceived by a user.

17 The nonlinear portion may be embodied in several different ways. For example, the
18 seam may have a few larger bends of substantially equal size, with few or no straight sections
19 between them. A larger number of smaller bends may also be used to decrease the width of
20 the nonlinear portion, while retaining the novel benefits of the bends. In the alternative, the
21 bends may have a very tight radius and simply connect linear segments in a zig-zag pattern.
22 Linear segments may also be connected by bends arranged in pairs, to create a seam with a
23 crankshaft-like appearance. Large-radius bends could even be used in combination with
24 linear segments, perhaps by arranging the bends between symmetrical linear segments.

25 The bends and linear segments, if used, need not be uniform in arrangement or
26 configuration. Any combination of the embodiments described above may be used

1 according to the invention. Any seam in which no linear portion of any linear segment of
2 any substantial length can be found is contemplated by the invention. Substantially linear
3 or nonlinear side portions of the seam may also be provided to enlarge the size of the
4 opening through which the airbag will deploy. Additionally, the seam need not follow a
5 generally linear course, but may be generally circular, semicircular, polygonal, or otherwise
6 in its overall shape.

7 In operation, expanding gases fill the airbag, and the airbag bursts through the seam.
8 Openings may form at one end of the seam and propagate rapidly from there to the other end,
9 or all parts of the seam may burst open simultaneously. If an outer layer is used, it may
10 break open in similar fashion. In any case, despite the irregular shape of the seam, it will still
11 open reliably as long as the seam is properly constructed, because the force tending to pull
12 the seam apart will remain substantially the same as with a straight seam. The fact that the
13 airbag deploys through a nonlinear opening will not substantially hinder its operation.

14 The seam of the present invention has application not only to driver and passenger
15 side airbags, but also to other vehicle airbags. For example, side mounted airbags designed
16 to protect occupants of a vehicle from lateral impact may utilize nonlinear tear seams to
17 ensure that the lateral surfaces of the vehicle, such as doors, armrests, and side ceiling
18 portions, do not show a seam or styling line where the airbag deploys. Similarly, airbags
19 used to protect a vehicle occupant's legs may have a nonlinear tear seam hidden from view.

20 Thus, the current invention provides a novel, nonlinear seam for an airbag cover.
21 If an outer layer is used, the nonlinear seam resists form-fitting of the outer layer over the
22 seam by providing a number of bends into which the outer layer cannot easily fit. As a
23 result, the outer layer maintains a much more attractive appearance and does not create a
24 temptation for a person to tamper with the seam, or to maintain any body part in dangerously
25 close proximity to the seam during operation of the vehicle.

26

1 Where a cosmetic surface is formed instead of the outer layer, the nonlinear seam
2 prevents read through of the thinner material of the seam, and thus obviates any styling line
3 used to hide the seam from view. The danger that a user will discover the seam and possibly
4 even break open the cover by pressing on the outer layer or the cosmetic surface is further
5 reduced. Hence, the seam of the present invention makes a vehicle safer, more attractive,
6 and more wear-resistant than previously known seams.

7 These and other features and advantages of the present invention will become more
8 fully apparent from the following description and appended claims, or may be learned by the
9 practice of the invention as set forth hereinafter.

10 11 **BRIEF DESCRIPTION OF THE DRAWINGS**

12 In order that the manner in which the above-recited and other advantages and objects
13 of the invention are obtained will be readily understood, a more particular description of the
14 invention briefly described above will be rendered by reference to specific embodiments
15 thereof which are illustrated in the appended drawings. Understanding that these drawings
16 depict only typical embodiments of the invention and are not therefore to be considered to
17 be limiting of its scope, the invention will be described and explained with additional
18 specificity and detail through the use of the accompanying drawings in which:

19 Figure 1 is an exploded view of a safety restraint device cover, including a module
20 with a seam having a nonlinear portion, according to the invention;

21 Figure 2 is a plan view of an alternative embodiment of a seam having a higher
22 number of bends;

23 Figure 3 is a plan view of another alternative embodiment of a seam having pointed
24 bends;

Figure 4 is a plan view of another alternative embodiment of a seam having a pairs of bends, the pairs oriented in consecutively opposite directions and separated by linear segments;

Figure 5 is a plan view of another alternative embodiment of the seam having linear segments disposed on either side of the bends;

Figure 6 is a plan view of another alternative embodiment of the seam having a mix of bends of different sizes and shapes intermingled with linear segments; and

Figure 7 is a perspective view of the safety restraint device cover of Figure 1 with an outer layer attached, concealing the seam.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The presently preferred embodiments of the present invention will be best understood by reference to the drawings, wherein like parts are designated by like numerals throughout. It will be readily understood that the components of the present invention, as generally described and illustrated in the figures herein, could be arranged and designed in a wide variety of different configurations. Thus, the following more detailed description of the embodiments of the apparatus, system, and method of the present invention, as represented in figures 1 through 6, is not intended to limit the scope of the invention, as claimed, but is merely representative of presently preferred embodiments of the invention.

As alluded to previously, airbags have become a great lifesaving tool for the automotive industry. For cosmetic and safety purposes, the airbags must be concealed underneath some type of solid, opaque cover after installation in a vehicle. Seams in the cover are necessary to ensure that the airbag inflates uniformly and through the correct part of the cover.

An outer layer may be applied to the cover to match the interior of the vehicle. However, known outer layers bend and fold to form-fit to the seam, thereby creating an

1 unsightly, distracting, and even potentially dangerous indentation over the airbag. The outer
2 layer may also be omitted in favor of single-shot construction, in which the cover is made
3 from a single piece of material. With a single-shot cover, the seam is typically formed inside
4 the cover. However, the seam may still be “read through” the cover, due to deflection the
5 regions surrounding the seam and the translucent nature of many thinly-constructed plastics.

6 The present invention makes novel use of principles of material deformation to
7 avoid the problems of the prior art. More specifically, a flat object bends far more readily
8 than a bent or creased object. This is because bending is easiest along thin cross sections,
9 and a bent or folded object has no thin cross section along which bending can easily occur.
10 For example, houses with peaked roofs can bear far heavier loads than houses with flat roofs.
11 Similarly, steel beams with an “I” shape are commonly used in construction because they
12 withstand bending far more effectively than flat beams, without the expense and weight of
13 a solid mass. In effect, an object that has already been bent or folded is somewhat thick
14 along any cross section, and therefore is much more difficult to bend in a second direction.

15 The same principle applies to objects that have not yet been bent or folded. When
16 an object is under multiple bending forces, each force limits the degree to which the other
17 force can bend the object because bending in one direction increases the thickness of the
18 object against bending in the other direction. As a result, the object may bend only slightly
19 in all directions.

20 The current invention applies this principle to a seam for an airbag cover. Straight
21 seams, like those of the prior art, will support the outer layer against bending in all directions
22 except for one, so the outer layer will bend in the unsupported direction to fold into the seam.
23 The present invention provides a meandering seam, so that the outer layer is supported
24 against bending in all directions. Some bending may occur in all directions, but that bending
25 is so minor as to be invisible to the naked eye. Additionally, small-scale, multi-directional
26

1 bending precludes further bending in all directions. The operation of this principle is further
2 illustrated in the following figures and their accompanying descriptions.

3 Referring to Figure 1, one possible embodiment of a cover 10 according to the
4 invention is shown. A module 12 is designed to be installed in an interior compartment (not
5 shown) of a vehicle. The module 12 has a peripheral surface 14, shaped to properly fit
6 against a mating surface in the vehicle, and a face portion 15 with an exterior side 16 facing
7 the seat of a vehicle occupant. A skirt 17 is attached to the face portion 15 or the peripheral
8 surface 14, and carries a series of locking tabs 18 designed to deform into locking
9 engagement with corresponding structures in the interior compartment of the vehicle.

10 The module 12 may be integrally formed from any suitable material, including
11 polymers, metals, ceramics, and composites. Alternatively, the various components of the
12 module 12, including the peripheral surface 14, the face portion 15, the and the skirt 17, may
13 be made from different materials assembled through means known in the art. The face
14 portion 15 and skirt 17 are preferably made of an elastomeric, deformable material such as
15 plastic. An airbag (not shown) may be attached to and installed with the module 12, or may
16 be installed within the interior compartment before installation of the cover 10.

17 A seam 20 is formed in the face portion 15 to permit deployment of the airbag
18 through the face portion 15. The seam 20 may take many forms, including an incision clear
19 through the face portion 15 held shut by sewn fibers, adhesives, welds, deformable locking
20 members, or other retention mechanisms known in the art. Alternatively, the seam 20 may
21 be simply a region in which the face portion 15 is made thinner than in the surrounding
22 regions, so that the seam 20 is the first portion to separate under stress. In such a
23 configuration, the material of the face portion 15 may slope inward from the exterior side 16
24 to create a seam 20 in the form of a trough. The seam 20 is not limited to the forms disclosed
25 herein, but includes any thin structure made to create an opening in a surface under stress.

26

1 The seam 20 includes a nonlinear portion 21, which is preferably centrally located
2 on the face portion 15. For the purposes of this application, "nonlinear" refers to any narrow
3 structure extending along a path from one end of the structure to the other, wherein the path
4 is not a straight line. Conversely, "linear" refers to narrow structures extending along a
5 straight line from one end of the structure to the other. Accordingly, a nonlinear object may
6 include linear segments if the overall path followed by the nonlinear object is not a straight
7 line. The nonlinear portion 21 satisfies this nonlinearity requirement because the path
8 followed by the nonlinear portion 21 between first and second ends 22 and 23 of the
9 nonlinear portion 21 is not a straight line.

10 The seam 20 preferably also includes a first side portion 24 attached to the first end
11 22 of the nonlinear portion 21, and a second side portion 25 attached to the second end 23
12 of the nonlinear portion 21. The first and second side portions 24 and 25 are oriented
13 generally perpendicular to the general orientation of the nonlinear portion 21 (a straight path
14 between the first and second ends 22 and 23). The side portions 24, 25 enlarge the size of
15 the opening formed when the airbag deploys, to permit more rapid and reliable deployment.

16 The nonlinear portion 21 includes a number of bends 26 that create a meandering
17 path between the first and second ends 22 and 23. According to this embodiment, the bends
18 26 are rounded. However, "bend" within this application is any feature in the nonlinear
19 portion 21 that changes the path along the nonlinear portion 21 between the first and second
20 ends 22, 23 in a clockwise or counterclockwise direction. Consequently, sharp turns as well
21 as curves of any radius constitute "bends."

22 An outer layer 30 may be attached to the exterior side 16 of the face portion 15 by
23 a means known in the art, including but not limited to chemical and adhesive bonding, heat
24 welding, RF welding, interference fitting, deformable locking members, and heat shrinking.
25 The outer layer 30 may be made from any suitable material, including polymers, metals,
26 ceramics, and composites. However, it is desirable that the outer layer 30 be attractive,

1 inexpensive, and weak enough to tear or detach from the exterior side 16 of the face portion
2 15 to permit deployment of the airbag. The outer layer 30 should also match the interior trim
3 of the vehicle. Consequently, plastics or other materials used in the vehicle interior are
4 preferred.

5 The ability of the outer layer 30 to form fit to the seam 20 is dependent upon the
6 stiffness of the material forming the outer layer 30, the thickness of the outer layer 30, and
7 the geometry of the seam 20. A thinner, more flexible outer layer 30 will more easily
8 conform to the shape of the seam 20. In order to permit deployment of the airbag, the outer
9 layer 30 must be substantially thin and flexible. Thus, the geometry of the seam 20 is the
10 critical factor in determining whether the seam 20 shows through the outer layer 30.

11 Linear deformation, in the form of a straight crease or bend in the outer layer 30,
12 readily occurs because deformation develops only along a thin cross-sectional area. When
13 the outer layer 30 is deformed in one direction, an intersecting deformation is much more
14 difficult to form because the first deformation effectively increases the thickness, and thereby
15 the sectional modulus, of the outer layer 30 along the line of the first deformation.
16 Consequently, existing deformations in the outer layer 30 make the outer layer 30 effectively
17 stiffer and more resistant to further deformation.

18 The bends 26 in the nonlinear portion 21 are critical for that reason. By constantly
19 changing the direction in which the outer layer 30 would have to deform to conform with the
20 seam 21, the bends 26 do not enable the outer layer 30 to significantly deform in any
21 direction. As a result, the outer layer 30 remains substantially flat, with a cavity between the
22 seam 20 and the outer layer 30, and the seam 20 is not visible to a passenger looking at the
23 outer layer 30. This effect will occur with any configuration of the seam 20 in which no
24 linear or near-linear trough lies underneath the outer layer 30. The curved bends 26 of this
25 embodiment are especially effective because there is no straight line of any length in the
26 nonlinear portion to which the outer layer 30 can conform itself. Depending on aesthetic and

1 material considerations, the first side portion 24 and the second side portion 25 may be
2 linear. The side portions 24, 25 may also be made nonlinear with a shape similar to that of
3 the nonlinear portion 21.

4 If desired, the outer layer 30 may also be omitted entirely, and the module 12 may
5 be constructed of a "single-shot" material. Single-shot processing is simply a fabrication
6 process, such as injection molding, that utilizes only a single material, and preferably one
7 single process. The exterior side 16 of the module 12 may be specially formed, through
8 texturing, aesthetic shaping, and the like, to create a cosmetic surface 16.

9 If no outer layer 30 is used, the seam 20 is preferably formed on the inside of the
10 module 12, i.e., on the interior side of the face portion 15 (not visible in Figure 1). The seam
11 20 may otherwise be configured as described above, with a nonlinear portion 21. The
12 nonlinear portion 21 then prevents read through because there is no viewpoint from which
13 a user may see through any substantial part of the seam 20. A user perceives no significant
14 unnatural variation in the cosmetic surface 16. Thus, no styling line need be formed in the
15 exterior side 16.

16 Additionally, whether the outer layer 30 is used, or the exterior side 16 is rather
17 made into a cosmetic surface 16, pressure applied against the face portion 15 of the cover 10
18 by a user does not bend the face portion 15 along any single axis. The seam 20 presents a
19 large variety of weakened bending axes, so that the face portion 15 bends inward in several
20 directions when pressure is applied. The seam 20 thus remains imperceptible to a user, and
21 a user has no reason to repeatedly exert any considerable pressure against the face portion
22 15.

23 Referring to Figure 2, an alternative embodiment of the seam 20 is presented. In this
24 embodiment, the nonlinear portion 21 has a multiplicity of smaller bends 36 to decrease the
25 width of the nonlinear portion. Smaller bends 36 may provide additional support for
26 especially flexible, thin materials that may be used in the outer layer 30. As with the

embodiment of Figure 1, there are no linear segments in the nonlinear portion 21, and the side portions 24 and 25 may be as shown, or may be made nonlinear as well.

Referring to Figure 3, another alternative embodiment of the invention is shown. In this configuration, the nonlinear portion 21 is composed of bends 40, in the form of substantially sharp corners 40, connected by linear segments 42. The linear segments 42 are short enough to inhibit folding of the outer layer 30 into the seam 20. Although possibly less effective at masking the seam 20 than the previous embodiments with rounded bends 26, 36, the substantially sharp corners 40 may provide design and manufacturing advantages while still keeping the outer layer 30 out of the seam 20.

Referring to Figure 4, yet another alternative embodiment of the invention is depicted. Traveling from the first end 22 to the second end 23 of the nonlinear portion 21, a counterclockwise bend 46 is followed by two adjacent clockwise bends 48, which are followed by two counterclockwise bends 46, etc. The counterclockwise and clockwise bends 46, 48 are separated by linear segments 50 like those of the previous embodiments. As with the previous embodiment, the linear segments 50 are short enough to prevent unidirectional deformation of the outer layer 30.

Referring to Figure 5, another alternative embodiment is shown. As depicted in Figure 5, the nonlinear portion 21 need not be a homogeneous pattern of linear or nonlinear segments. First and second linear segments 56 and 57, positioned at the first and second ends 22 and 23 of the nonlinear portion 21, respectively, may be connected by a nonlinear segment 58. The nonlinear portion 21 is still nonlinear because the path along the nonlinear portion 21 between the first and second ends 22 and 23 is only partially straight.

Referring to Figure 6, yet another alternative embodiment is depicted. The nonlinear portion 21 of the seam 20 may include a mixture of bends 60 and linear segments 62 of various shapes and sizes. The seam 20 need not be precisely formed, and will not show

1 through the outer layer 30 as long as the requisite nonlinear features are found. The bends
2 60 may also be distributed asymmetrically along the seam 20.

3 Referring to Figure 7, the cover 10 of the present invention is shown with the seam
4 20 hidden. If an outer layer 30 is used, it has been attached to the exterior side 16 of the
5 cover 10, as depicted in Figure 7. The outer layer 30 may be installed by any known method,
6 including but not limited to adhesive bonding, chemical bonding, heat bonding, vacuum
7 forming, RF welding, mechanical fastening, swaging, and sewing. The outer layer 30 shows
8 little or no sign of the seam 20 because the outer layer 30 is not form-fitted to the seam 20.

9 However, if no outer layer 30 has been used, the exterior side 16 is simply formed
10 as a cosmetic surface 16. In such a case, the cover 10 appears as shown in Figure 7, except
11 that no outer layer 30 is present. The seam 20 is substantially invisible, even though there
12 is no styling line on the cosmetic surface 16, because the seam 20 is nonlinear and therefore
13 prevents read through. Similarly, any deformation that occurs in the cosmetic surface due
14 to the seam 20 is also relatively unobservable.

15 Thus, the cover 10 is ready for installation in a vehicle. The locking tabs 18 may
16 be aligned with suitable receptacles in the vehicle so that the cover 10 is held firmly within
17 the vehicle. The outer layer 30, if present, appears simply as a panel; any designs be formed
18 on the panel before or after installation in the vehicle without the interference of the seam
19 20.

20 Accordingly, the principles of material deformation are effectively applied by the
21 present invention. The meandering nature of the seam 20 ensures that there is no single axis
22 along which the outer layer 30 can visibly bend. As a result, the seam 20 is effectively
23 hidden, and will not interfere with design schemes for the vehicle interior. Furthermore,
24 occupants of the vehicle are not drawn to damage the outer layer 30 over the seam or keep
25 their arms and hands in dangerous proximity to the airbag. Thus, the novel seam 20 of the
26

1 present invention keeps the outer layer 30 flat, thereby making the entire cover 10 for an
2 airbag more attractive, hassle-free, and safe.

3 The present invention may be embodied in other specific forms without departing
4 from its structures, methods, or other essential characteristics as broadly described herein and
5 claimed hereinafter. The described embodiments are to be considered in all respects only as
6 illustrative, and not restrictive. The scope of the invention is, therefore, indicated by the
7 appended claims, rather than by the foregoing description. All changes that come within the
8 meaning and range of equivalency of the claims are to be embraced within their scope.

9 What is claimed and desired to be secured by United States Letters Patent is:

1 1. A cover for a safety restraint device for use in a vehicle, the cover comprising:
2 a face portion capable of being positioned between the safety restraint device and
3 an interior compartment of the vehicle, the face portion comprising an exterior side facing
4 away from the safety restraint device; and

5 a seam formed in the face portion, the seam comprising a nonlinear portion having
6 a first end and a second end, the nonlinear portion comprising a plurality of bends in
7 consecutively alternating directions.

8
9 2. The cover of claim 1, further comprising an outer layer affixed to the exterior side
10 of the face portion.

11
12 3. The cover of claim 1, wherein the bends are adjacent to each other, exclusive of
13 any linear segment therebetween.

14
15 4. The cover of claim 1, wherein the seam further comprises a linear segment
16 disposed between and adjacent to two of the bends.

17
18 5. The cover of claim 1, wherein the nonlinear portion further comprises a first
19 linear segment positioned proximate the first end of the nonlinear portion.

20
21 6. The cover of claim 5, wherein the nonlinear portion further comprises a second
22 linear segment positioned proximate the second end of the nonlinear portion.

23
24 7. The cover of claim 6, wherein the nonlinear portion further comprises a nonlinear
25 segment positioned between the first and second linear segments.

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1 8. The cover of claim 1, wherein the nonlinear portion further comprises a plurality
2 of pairs of bends, each pair comprising two bends oriented in the same direction, the pairs
3 oriented in consecutively alternating directions.

4
5 9. The cover of claim 1, wherein the bends are substantially sharp corners.

6
7 10. The cover of claim 1, wherein the bends are of nonuniform size and shape.

8
9 11. The cover of claim 1, wherein the seam further comprises:
10 a first side portion substantially perpendicular to the first end of the nonlinear
11 portion; and
12 a second side portion substantially perpendicular to the second end of the nonlinear
13 portion.

14
15 12. The cover of claim 11, wherein the first side portion is adjacent to the first end
16 of the nonlinear portion, and the second side portion is adjacent to the second end of the
17 nonlinear portion.

18
19 13. The cover of claim 12, wherein the first and second side portions are
20 substantially linear.

21
22 14. The cover of claim 1, wherein the face portion is formed by single-shot
23 construction and wherein the face portion operates exclusive of an outer layer.

1 15. The cover of claim 14, wherein the seam is further formed in an interior side of
2 the face portion, the interior side facing toward the safety restraint device, and wherein the
3 exterior side of the face portion comprises a cosmetic surface.
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1 16. A cover for a safety restraint device for use in a vehicle, the cover comprising:
2 a face portion positionable between the safety restraint device and an interior
3 compartment of the vehicle, the face portion comprising an exterior side facing away from
4 the safety restraint device; and

5 a seam formed in the face portion, the seam comprising a nonlinear portion, the
6 nonlinear portion comprising a plurality of bends in consecutively alternating directions, the
7 bends being adjacent to each other and substantially exclusive of any linear segment
8 therebetween.

9
10 17. The cover of claim 16, wherein the seam further comprises:
11 a first end; and
12 a second end positioned opposite the first end.

13
14 18. The cover of claim 17, wherein the seam further comprises:
15 a first side portion adjacent and substantially perpendicular to the first end of the
16 nonlinear portion, the first side portion being substantially linear; and
17 a second side portion adjacent and substantially perpendicular to the second end of
18 the nonlinear portion, the second side portion being substantially linear.

19
20 19. The cover of claim 18, further comprising an outer layer affixed to the exterior
21 side of the face portion.

22
23 20. The cover of claim 18, wherein the face portion is formed by single-shot
24 construction, and wherein the face portion operates exclusive of an outer layer.

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1 21. A cover for a safety restraint device for use in a vehicle, the cover comprising:
2 a face portion positionable between the safety restraint device and an interior
3 compartment of the vehicle, the face portion comprising an exterior side facing away from
4 the safety restraint device; and

5 a seam formed in the face portion, the seam comprising:

6 a nonlinear portion having a first end and a second end, the nonlinear portion
7 comprising a plurality of bends in consecutively alternating directions, the bends
8 being adjacent to each other and substantially exclusive of any linear segment
9 therebetween;

10 a first side portion adjacent and substantially perpendicular to the first end of
11 the nonlinear portion, the first side portion being substantially linear; and

12 a second side portion adjacent and substantially perpendicular to the second
13 end of the nonlinear portion, the second side portion being substantially linear.
14

15 22. The cover of claim 21, further comprising an outer layer affixed to the exterior
16 side of the face portion.
17

18 23. The cover of claim 21, wherein the face portion is formed by single-shot
19 construction, and wherein the face portion operates exclusive of an outer layer.
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1 24. A method for making a cover for a safety restraint device for use in a vehicle,
2 the method comprising:

3 providing a face portion adapted to be installed between the safety restraint device
4 and an interior compartment of the vehicle, the face portion comprising an exterior side
5 facing away from the safety restraint device; and

6 forming a seam in the face portion, the seam having a nonlinear portion with a first
7 end and a second end, the nonlinear portion comprising a plurality of bends in consecutively
8 alternating directions.

9
10 25. The method of claim 24, further comprising affixing an outer layer to the face
11 portion, over the seam.

12
13 26. The method of claim 24, further comprising forming a cosmetic surface in the
14 exterior side, wherein the seam is formed on an interior side of the face portion, the interior
15 side facing toward the safety restraint device.

16
17 27. The method of claim 24, further comprising forming a first side portion adjacent
18 and substantially perpendicular to the first end of the nonlinear portion, the first side portion
19 being substantially linear.

20
21 28. The method of claim 27, further comprising forming a second side portion
22 adjacent and substantially perpendicular to the second end of the nonlinear portion, the
23 second side portion being substantially linear and parallel to the first side portion.

1 29. The method of claim 28, wherein the seam comprises a recessed portion of the
2 face portion, the recessed portion having a thickness smaller than an average thickness of the
3 face portion.
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AIRBAG PRODUCTS WITH NONLINEAR TEAR SEAMS

ABSTRACT OF THE INVENTION

A novel cover for a safety restraint device is disclosed. The cover is well-adapted for use in vehicles with modular airbag components. The novel cover configuration of the present invention effectively hides any evidence of the seam through which the airbag deploys, thereby improving the appearance and tamper-resistance of the airbag. The cover includes a seam with a nonlinear portion that impedes folding or bending of the outer layer in conformance with the seam. The nonlinear portion of the seam may include bends and linear segments in a variety of shapes and sizes, in homogeneous or heterogeneous arrangements, as dictated by the design parameters of the airbag and the manufacturing processes used to make the cover. The cover module of the present invention may be used with an outer layer of material designed to conceal the seam. With such a configuration, the nonlinear portion of the seam may keep the outer layer from form fitting to the seam so that no visible indentation over the seam will be shown. Alternatively, the module may be made with a single-shot material, exclusive of any outer layer. An exposed surface of the airbag module may then be configured as a cosmetic surface, with the seam formed on the opposite side of the cosmetic surface. The nonlinear seam then reduces material deformation and obscures translucency to ensure that the cosmetic surface appears even and relatively flat, even without the use of a styling line.

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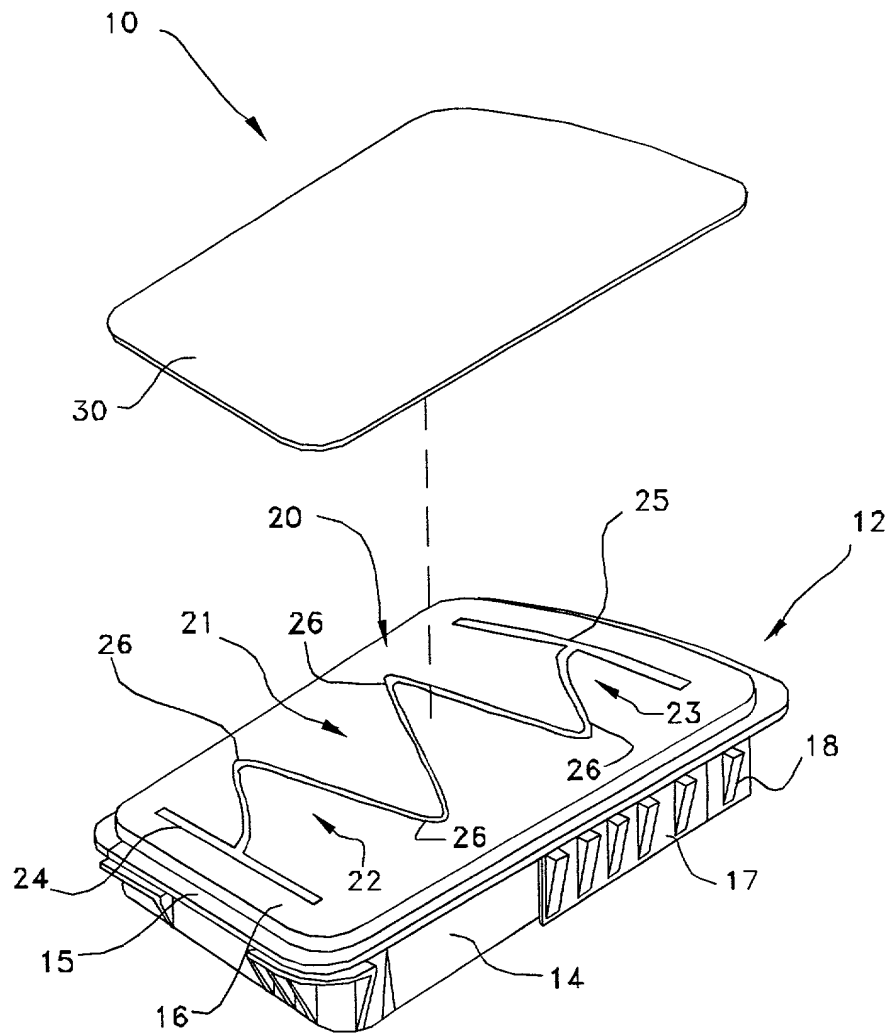


FIG. 1

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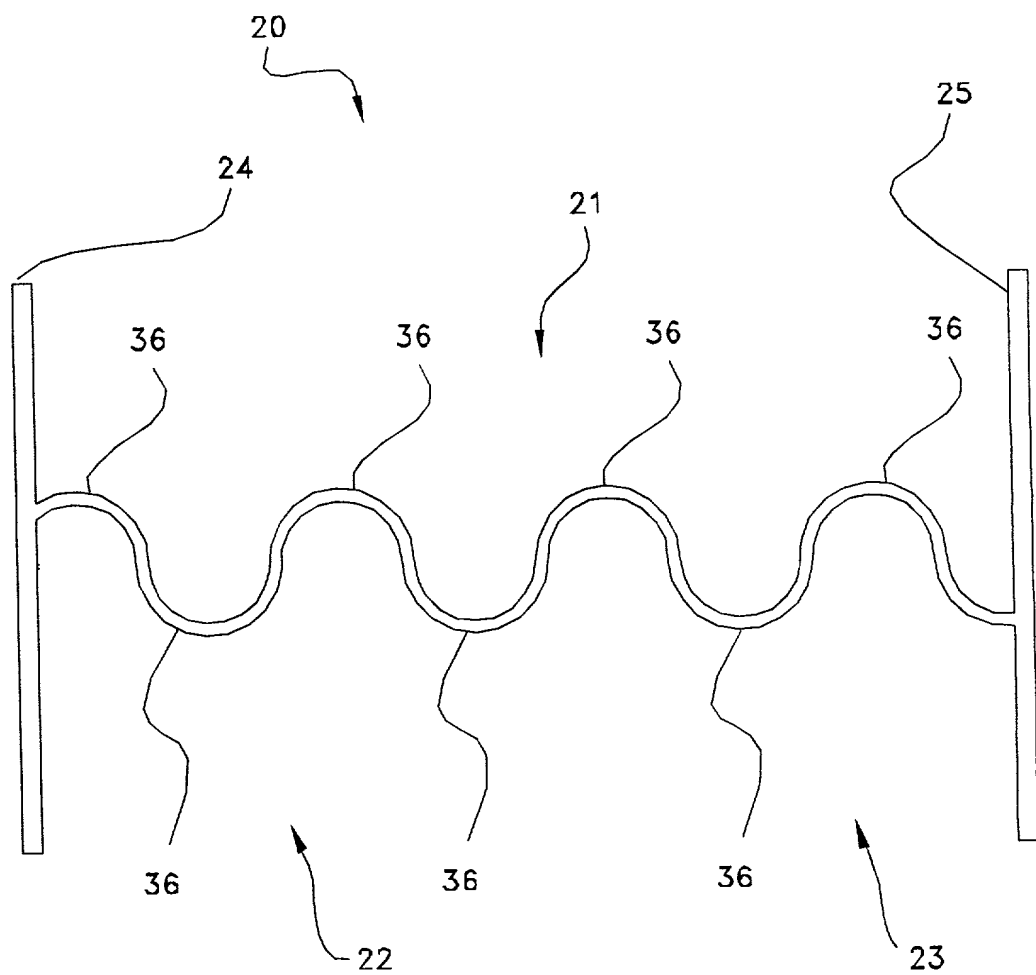


FIG. 2

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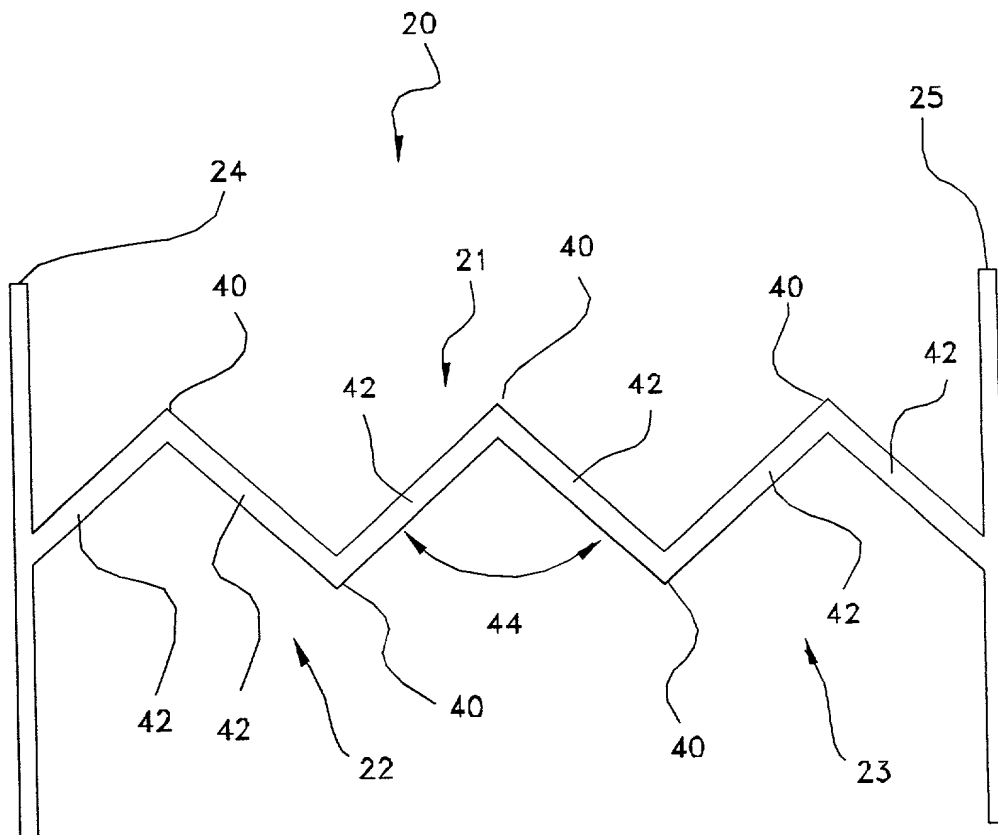


FIG. 3

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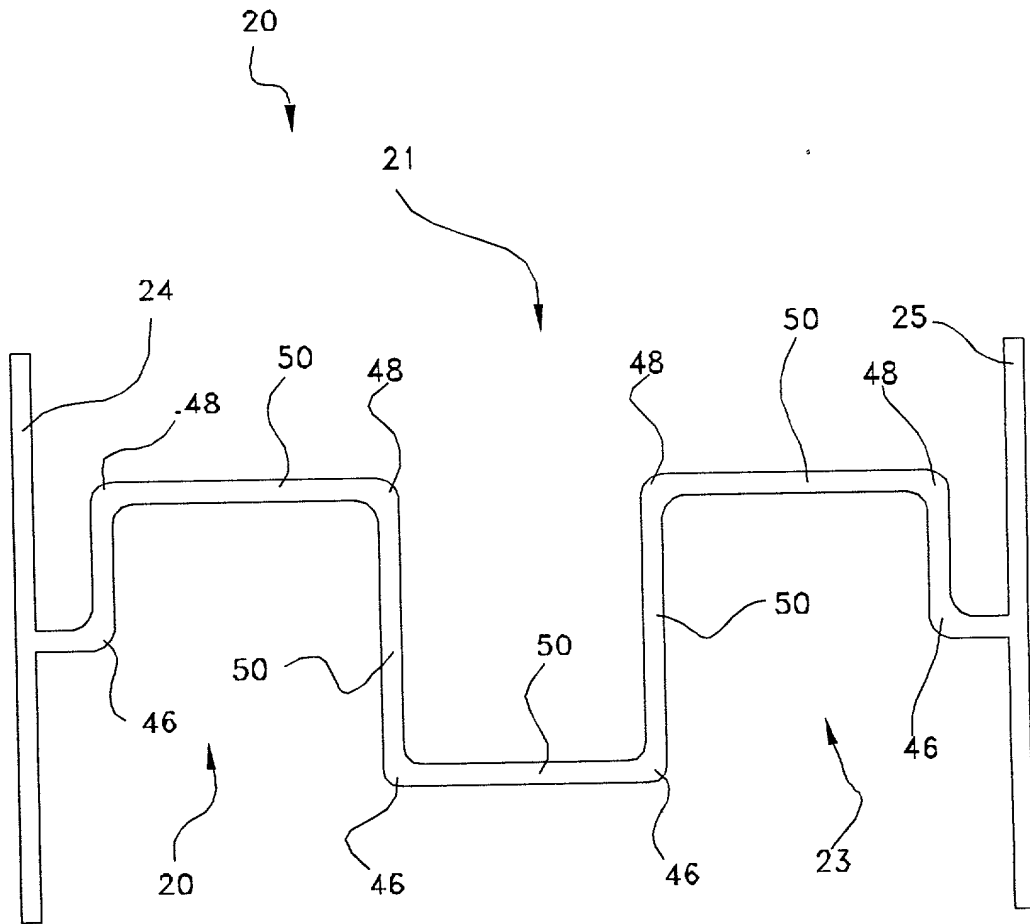


FIG. 4

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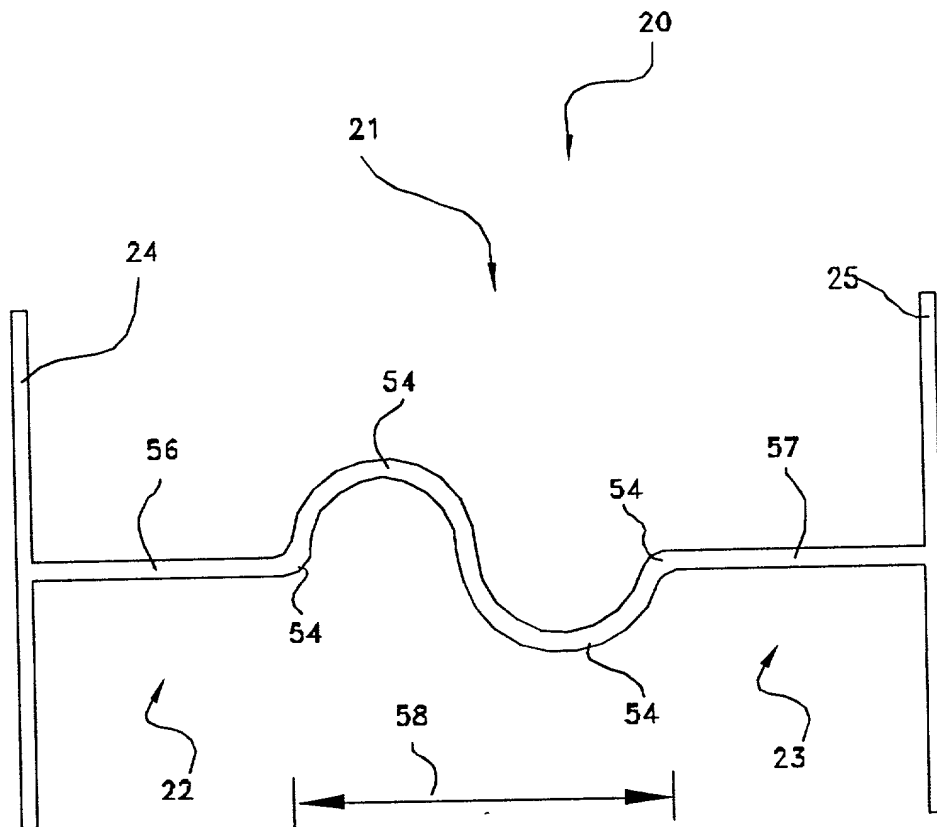


FIG. 5

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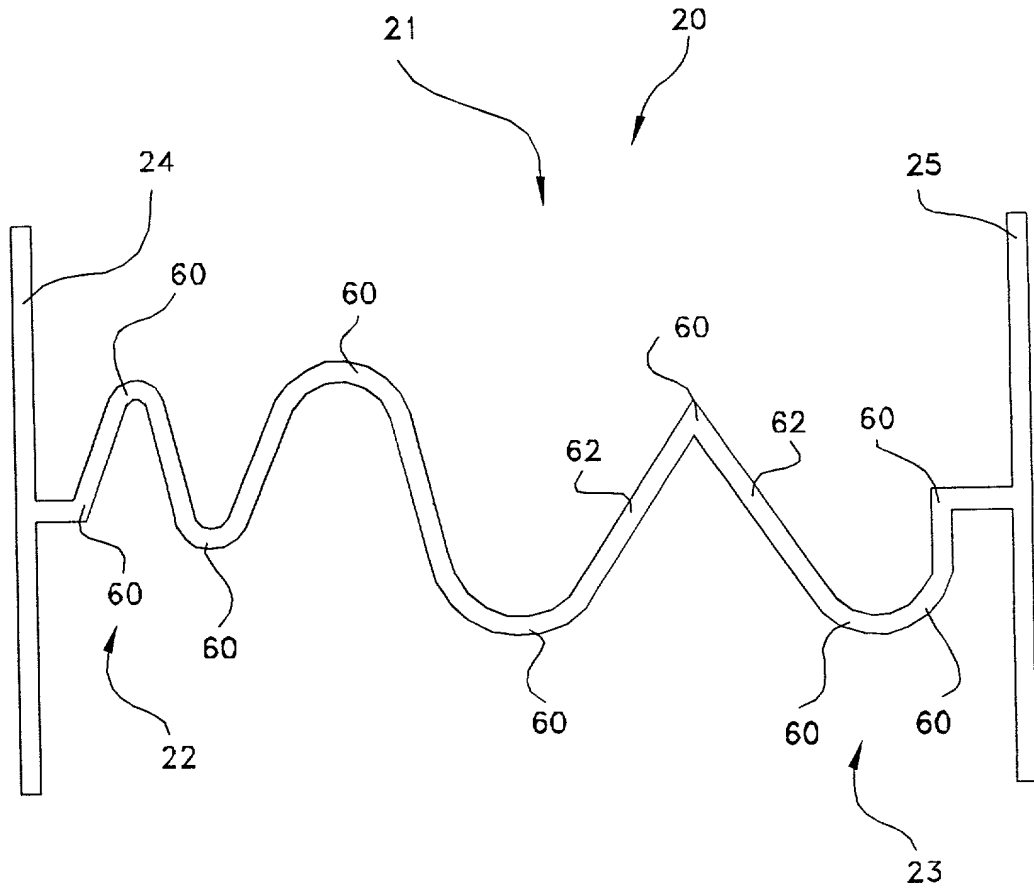


FIG. 6

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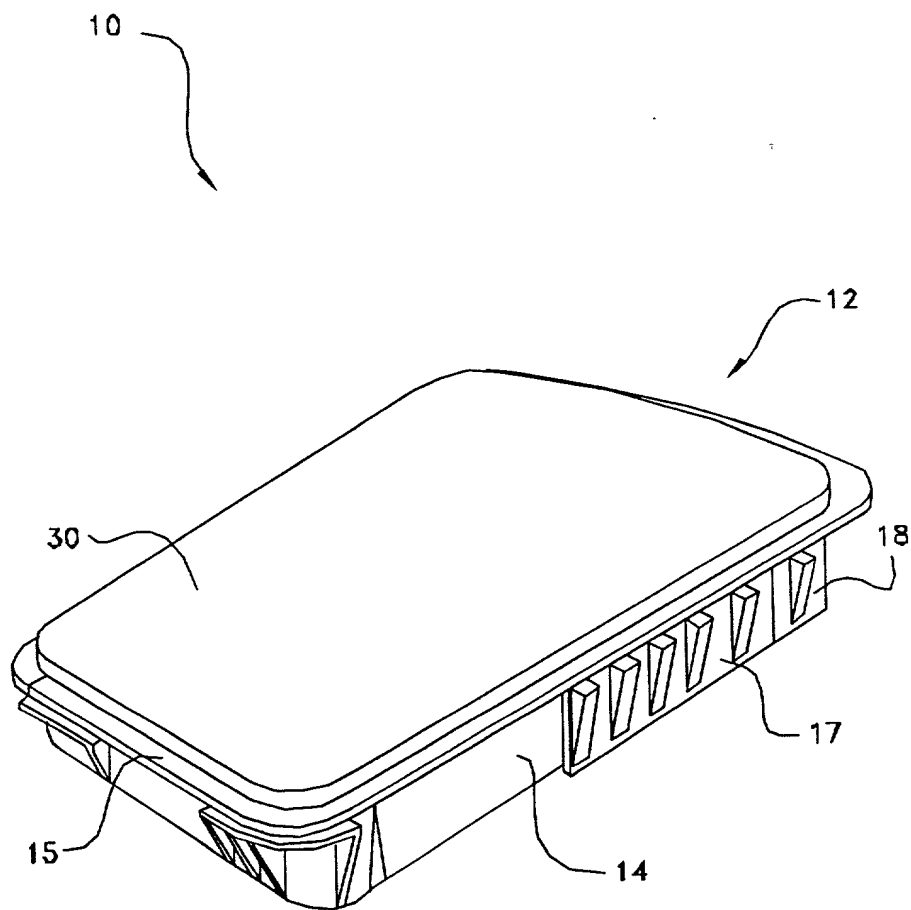


FIG. 7

Combined Declaration and Power of Attorney

Attorney's Docket No.: 14097

(Original, Design, National Stage of PCT, Supplemental, Divisional, Continuation or CIP Application)

As a below named inventor, I hereby declare that:

Type of Application

This declaration is for the original application:

Inventorship Identification

My residence, post office address and citizenship are as stated below next to my name. I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

AIRBAG PRODUCTS WITH NON-LINEAR TEAR SEAMS

Specification Identification

the specification of which:

- a) ☒ is attached hereto.
- b) _____ was filed on _____ as application Serial No. _____ and was amended on _____ (if applicable).
- c) _____ was described and claimed in PCT International Application No. _____ filed on _____
and as amended under PCT Article 19 on _____ (if any).

Acknowledgements of Review of Papers and Duty of Candor

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Patent and Trademark Office all information known to the inventor to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

____ In compliance with this duty there is attached an information disclosure statement. 37 CFR 1.97.

Priority Claim

I hereby claim foreign priority benefits under Title 35, United States Code Section 119, of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

- d) ☒ no such applications have been filed.
- e) _____ such applications have been filed as follows:

Earliest foreign application(s), if any, filed within 12 months
(6 months for design) prior to this U.S. application.

Country	Application Number	Date of Filing (month, day, year)	Priority Claimed	
			Under 37	USC 119

All foreign application(s), if any, filed more than 12 months
(6 months for design) prior to U.S. application

Power of Attorney

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

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(Name and telephone number)

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(801) 625-4934

Declaration

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signatures

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Inventor's signature

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August 28, 2000

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Post Office Address: SAME

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Inventor's signature

Date:

9-1-2000

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Inventor's signature

Date:

Country of Citizenship:

Residence:

Post Office Address: SAME

Type or print name of fourth joint inventor, if any

Inventor's signature

Date:

Country of Citizenship:

Residence:

Post Office Address: SAME

Type or print name of fifth joint inventor, if any

Inventor's signature

Date:

Country of Citizenship:

Residence:

Post Office Address: SAME

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